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(54) Threaded fastener

(57) A threaded fastener has a substantially single helical thread formed upon a shank portion (12) thereof, and a plurality of substantially saw-blade type or serrated teeth (30) are formed upon crest portions of leading ones of individual thread portions of the helical thread (22). The saw-blade type or serrated teeth cut into ride wall portions of any one of a multiplicity of substrates so as to substantially reduce required insertion torque levels, render fastener insertion operations quicker, and enhance fastener pull-out resistance values.

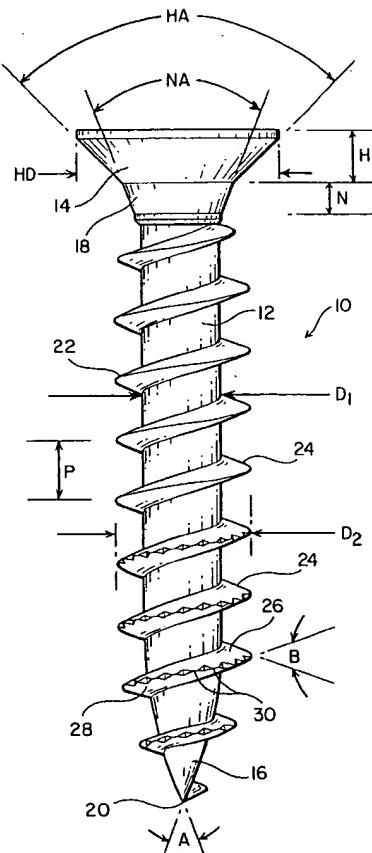


FIG. 1

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Description

[0001] The present invention relates generally to threaded fasteners, and more particularly to a new and improved threaded fastener which has uniquely formed or fabricated saw-tooth or serrated-teeth structure integrally formed upon the peripheral edge regions of the crest portions of the lead threads of the fastener whereby the cutting performance or characteristics of the lead threads is enhanced so as to in turn facilitate and enhance the penetration or insertion rate of the fastener into a substrate, as well as the pullout resistance of the fastener, and still further, the new and improved fastener is well-adapted for threaded insertion within a plurality of different substrates, such as, for example, wood, metal, composite materials, concrete, or the like. In connection with the fabrication or manufacture of threaded fasteners, a multiplicity of different fasteners are of course well-known and are accordingly available in the marketplace: More particularly, or furthermore, the multiplicity or different varieties of threaded fasteners have been developed in accordance with various objectives, such as, for example, to enable the fasteners to achieve predetermined desired insertion and withdrawal torque characteristics, to enable the fasteners to be used in conjunction with different mounting panels, support surfaces, or substrates comprising different types of materials, to enable the fasteners to exhibit predetermined desired pull-out resistance values with respect to such panels, surfaces, or substrates, and the like. Accordingly, the threads of such fasteners are usually provided with supplemental or auxiliary structure, which seeks to achieve the aforesaid objectives. For example, as disclosed within United States Patent 5,110,245 which issued to Hiroyuki on May 5, 1992, the peripheral edge portions of the threads of the threaded fasteners 1 disclosed therein are provided with slot recesses 6 in order to render the fasteners 1 suitable for enhanced stability within thermoplastic resin substrates. In a similar manner, as disclosed within United States Patent 5,044,853 which issued to Dicke on September 3, 1991, the peripheral edge portions of the threaded fastener are provided with parabolic depressions wherein the dispositions of the depressions are effectively skewed such that the insertion torque is less than the withdrawal torque thereby rendering the screwing of the fastener into the particular substrate relatively easier than the unscrewing of the fastener from the substrate. Lastly, as disclosed within United States Patent 4,637,767 which issued to Yaotani et al. on January 20, 1987, the threads of the fastener are provided with projections 150 so as to optimise torque levels as well as pull-out resistance values. While the aforesaid exemplary threaded fasteners have performed satisfactorily and have accordingly been commercially successful, a need still exists in the art for a new and improved threaded fastener which will have new and improved structure integrally incorporated within the lead thread portions thereof whereby such lead threads can effectively cut into a diverse type of substrates in a relatively faster and smoother manner, such as, for example, wood, metal, composite materials, concrete, or the like. In addition, the lead threads can effectively cause the removal of cut material and the dispersal of the same so as to permit the following or trailing threads to easily traverse the newly formed threads which have been tapped into the substrates by means of the newly structured lead threads, and wherein, as a result of such new and improved screw fastener thread structure, the screw fastener will exhibit enhanced tapping or insertion torque characteristics, enhanced tapping and insertion speed, and improved pull-out resistance properties. Accordingly, it is an object of the present invention to provide a new and improved threaded screw fastener. Another object of the present invention is to provide a new and improved threaded screw fastener which effectively overcomes the various disadvantages and drawbacks characteristic of PRIOR ART threaded screw fasteners. An additional object of the present invention is to provide a new and improved threaded screw fastener which has new and improved cutting structure integrally incorporated within the peripheral crest regions of the leading threads such that the new and improved threaded screw fastener is uniquely adapted for use in conjunction with a multiplicity of different types of substrates such as, for example, wood, metal, composites, concrete, or the like. A further object of the present invention is to provide a new and improved threaded screw fastener which has new and improved cutting structure integrally incorporated within the peripheral crest regions of the leading threads such that the new and improved threaded screw fastener is uniquely adapted for actually cutting, removing, and dispersing material from the particular substrate during the performance of a tapping operation. A last object of the present invention is to provide a new and improved threaded screw fastener which has new and improved cutting structure integrally incorporated within the peripheral crest regions of the leading threads such that the new and improved threaded screw fastener is uniquely adapted for actually cutting, removing, and dispersing material from the particular substrate during the performance of a tapping operation such that torque insertion requirements are diminished, insertion speed is enhanced, and pull-out resistance properties are improved. The foregoing and other objectives are achieved in accordance with the teachings and principles of the present invention through the provision of a new and improved threaded screw fastener which comprises a shank portion, a tip portion, and a head portion. The shank portion has, for example, a single, continuous, helical thread integrally formed thereon, and the leading thread portions each have serrated teeth integrally formed within and along the crest portions thereof. The serrated teeth each have a substantially triangular configuration with valley regions formed between adjacent ones of the serrated teeth having, or defined by, included angles of 100°. The serrated teeth thus serve, in effect, as saw-blade type teeth which actually cut threads into the substrate walls, as opposed to in effect simply moving substrate material from the tapped regions, and the thread structure also serves to remove and disperse the cut debris such that the following or trailing thread

portions can smoothly and quickly traverse the previously tapped threads. In this manner, the insertion torque level and installation time are substantially reduced, and still further, the fastener exhibits enhanced pull-out resistance values.

[0002] Various other objects, features, and attendant advantages of the present invention will be more fully appreciated from the following detailed description when considered in connection with the accompanying drawings in which like reference characters designate like or corresponding parts throughout the several views, and wherein:

FIGURE 1 is a vertical front elevational view of a new and improved threaded screw fastener constructed in accordance with the principles and teachings of the present invention wherein the lead threads of the screw fastener are provided with the plurality of unique and novel, circumferentially arranged saw-blade type teeth upon the other peripheral edge regions of the lead thread crest portions; and

FIGURE 2 is an enlarged, partial cross-sectional, bottom perspective view of a lead thread portion of the new and improved threaded screw fastener shown in FIGURE 1, wherein the details of the saw-blade type teeth, integrally formed upon the other peripheral edge regions of the lead thread crest portions of the single continuous helical thread formed upon the threaded screw fastener so as to achieve the advantageous torque, insertion, and pull-out resistance properties characteristic of the present invention, are particularly illustrated.

[0003] Referring now to the drawings, and more particularly to FIGURE 1 thereof, a new and improved threaded screw fastener, constructed in accordance with the principles and teachings of the present invention wherein the lead threads of the screw fastener are provided with the plurality of unique and novel, circumferentially arranged saw-blade type teeth upon the outer peripheral edge regions of the lead thread crest portions so as to achieve reduced insertion torque characteristics rendering the insertion or installation procedure quicker and faster, as well as enhancing pull-out resistance values, is disclosed and is generally indicated by the reference character 10. More particularly, the threaded screw fastener 10 comprises a shank portion 12 of substantially constant diameter D_1 , and a tapered head portion 14 formed upon the upper end of the shank portion 12, wherein the tapered head portion 14 has an axial depth or thickness H , a diametrical extent HD , and an included taper angle HA of approximately 85-90°. A pointed tip portion 16 is formed upon the lower end of the shank portion 12, and a tapered neck portion 18 integrally interconnects the tapered head portion 14 of the fastener 10 to the upper end of the shank portion 12. The tapered neck portion 18 has an axial depth or thickness N and an included taper angle NA of approximately 48-52°, and it is noted that the pointed tip portion 16 comprises an end point 20 at which diametrically opposite sides or planes of the pointed tip portion 16 effectively intersect each other at an angle A which is within the range of 20-25°. A single continuous helical thread 22 is formed upon the shank and tip portions 12, 16 of the fastener 10, and it is noted that the individual threads 24, comprising the overall single continuous helical thread 22 and which are formed upon the constant diameter portion D_1 of the shank portion 12 so as to have a pitch P defined there between, have an external crest diameter dimension D_2 . Still further, it is noted that each one of the individual threads 24 comprises an upper flank or surface 26 and a lower flank or surface 28 wherein planes defined within the upper and lower flanks or surfaces 26, 28 effectively intersect each other at an angle B which is within the range of 30-50°, and preferably has a value of 40°. In accordance with the principles and teachings of the present invention, it is further seen from FIGURE 1, and as may best be seen from FIGURE 2, that the individual leading threads 24 of the threaded screw fastener 10 are provided with unique and novel structure comprising a series of saw-blade type or serrated teeth 30 which are integrally formed upon the outer peripheral edge regions of the leading thread crest portions 32 of the single continuous helical thread 22 formed upon the threaded screw fastener 10 so as to enable or facilitate achievement of the advantageous insertion, torque, and pull-out resistance properties characteristic of the new and improved threaded screw fastener 10. It is to be initially noted that, in connection with the provision of such unique and novel structure comprising the series of saw-blade type teeth 30 integrally formed upon the outer peripheral edge regions of the leading thread crest portions 32 of the single continuous helical thread 22 formed upon the threaded screw fastener 10, and in view of the additional fact that the threaded screw fastener 10 may have any suitable longitudinal or axial length dimension, such as, for example, between 0.625 inches and 3.50 inches, the saw-blade type teeth 30 are provided upon those individual leading threads 24 which are disposed within approximately the leading one-third or one-half axial extent of the threaded screw fastener 10 as measured from the pointed tip 20 to the head portion 14. With reference therefore now being specifically made to FIGURE 2, the detailed structure of the unique and novel series of saw-blade type teeth 30, as integrally formed upon the outer peripheral edge regions of the leading thread crest portions 32 of the single continuous helical thread 22 formed upon the threaded screw fastener 10, will now be described. More particularly, it is seen that as a result of the use of suitably specific tooling, not shown, but which may be, for example, a suitable rolling die, the outer peripheral edge regions of the leading thread crest portions 32 of the single continuous helical thread 22 have 25 the continuous series or set of saw-blade teeth 30 formed therein such that valley regions 34 interposed between adjacent ones of the saw-blade teeth 30 are defined by means of an included angle IA of approximately 100°. In addition, it is further noted that the tooth pitch TP , or in other words, the circumferential distance defined between adjacent saw-blade teeth

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30, will have predetermined values, as will be noted hereinafter in connection with several fabricated examples of the new and improved threaded screw fastener 10 of the present invention, depending upon the particular diametrical size of the fastener 10, and in a similar manner, each one of the saw-blade teeth 30 will have a predetermined depth dimension TD, that is, the radial distance defined between the radially outermost tip of each tooth 30 to the base of each tooth 30, which will also accordingly vary depending upon the particular diametrical size of the fastener 10. It is lastly noted that each saw-blade tooth 30 can have a predeterminedly dimensioned width W, as measured in the peripheral or circumferential direction, which can be optimally varied so as to in fact achieve different degrees of cutting efficiency depending upon the particular substrate material into which the self-tapping fasteners 10 are being inserted.

[0004] As has been noted above, various conventionally sized threaded screw fasteners can have the unique and novel saw-blade teeth 30, constructed in accordance with the principles and teachings of the present invention, incorporated therein, and accordingly, the following examples of fasteners 10, provided with the saw-blade teeth 30 of the present invention, are set forth wherein the particular structural 25 and size characteristics of the saw-blade teeth 30, and their interoperative cooperation, will become readily apparent:

15	EXAMPLE 1 - A NUMBER 6	SIZED	SCREW FASTENER
	Head Diameter -	HD -	6.40-6.80 mm
	Head Thickness -	H -	2.20 mm
	Neck Thickness -	N -	1.40 mm
20	Shank Diameter -	D ₁ -	2.20 mm
	Thread Crest Diameter -	D ₂ -	3.30-3.60 mm
	Thread Pitch	p -	1.80 mm
	Saw-Blade Teeth Pitch -	TP -	0.60
	Saw-Blade Teeth Depth -	TD -	0.21 mm
25	Saw-Blade Teeth Included Angle -	IA -	100 Degrees

30	EXAMPLE 2 A NUMBER 8	SIZED	SCREW FASTER
	Head Diameter -	HD	7.70-8.10 mm
	Head Thickness -	H	2.50 mm
	Neck Thickness-	N	1.60 mm
	Shank Diameter -	D ₁	2.40 mm
	Thread Crest Diameter -	D ₂	3.80-4.10 mm
	Thread Pitch -	p	2.00 mm
	Saw-Blade Teeth.Pitch -	TP	0.60 mm
	Saw-Blade Teeth Depth -	TD	0.21 mm
35	Saw-Blade Teeth Included Angle -	IA	100 Degrees

40	EXAMPLE 3 - A NUMBER 10	SIZED	SCREW FASTENER
	Head Diameter -	HD -	9.10-9.50 mm
	Head Thickness -	H -	2.80 mm
	Neck Thickness -	N -	1.80 mm
	Shank Diameter -	D _i -	3.03 mm
	Thread Crest Diameter -	D ₂ -	4.80-5.10 mm
	Thread Pitch -	P -	2.60 mm
	Saw-Blade Teeth Pitch -	TP -	0.70 mm
	Saw-Blade Teeth Depth -	TD -	0.25 mm
50	Saw-Blade Teeth IncludedAngle -	IA -	100 Degrees

55	EXAMPLE 4 - A NUMBER 12	SIZED	SCREW FASTENER
	Head Diameter -	HD -	10.30-10.80 mm

(continued)

EXAMPLE 4 - A NUMBER 12	SIZED	SCREW FASTENER
Head Thickness -	H -	3.10 mm
Neck Thickness -	N -	2.00 mm
Shank Diameter -	D ₁ -	3.30 mm
Thread Crest Diameter -	D ₂ -	5.30-5.60 mm
Thread Pitch -	P -	2.90 mm
Saw-Blade Teeth Pitch -	TP -	0.70 mm
Saw-Blade Teeth*Depth-	TD -	0.25 mm
Saw-Blade Teeth Included Angle -	IA -	100 Degrees

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EXAMPLE 5 A NUMBER 14	SIZED	SCREW FASTENER
Head Diameter -	HD -	11.90-12.40 mm
Head Thickness -	H	3.40 mm
Neck Thickness -	N -	2.20 mm
Shank Diameter -	D ₁ -	3.60 mm
Thread Crest Diameter -	D _z -	5.80-6.10 mm
Thread Pitch -	P -	3.10 mm
Saw-Blade Teeth Pitch -	TP -	0.80 mm
Saw-Blade Teeth Depth -	TD -	0.29 mm
Saw-Blade Teeth Included Angle -	IA -	100 Degrees

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[0005] In connection with any one of the aforementioned examples of threaded screw fasteners 10 which may be fabricated in accordance with the principles and teachings of the present invention, it is to be emphasized that as a result of the provision of the continuous series of saw-blade teeth 30 upon the outer peripheral edge regions of the leading thread crest portions 32 of the single continuous helical thread 22, the saw-blade teeth 30 will effectively cut and remove material forming the side wall portions of bores defined within any one of a multiplicity of substrates, as opposed to simply moving or displacing the material forming the side walls of the substrate bores, as is conventionally achieved by PRIOR ART self-tapping threaded fasteners. This cutting and removal action accomplished by means of the new and improved threaded screw fastener 10 of the present invention therefore leads to a faster and smoother insertion of the fastener 10 into a particular substrate, and the fact that material is actually cut and removed from the side wall portions of the substrate bores permits the following or trailing threads to be inserted or installed more easily. Accordingly, the overall required insertion torque levels are substantially reduced, and due to the well-defined cuts within the side walls of the substrate, the pull-out resistance values characteristic of the fasteners 10 are substantially enhanced. It is further noted that the severed and removed substrate material or debris does not present any problems with respect to the operational efficiency of the threaded fasteners 10 in view of the fact that such material or debris will be shifted toward the shank portion 12 of the fastener 10 and will also drop downwardly and collect within the bottom regions of the substrate bores. Thus, it may be seen that in accordance with the principles and teachings of the present invention, there has been provided a new and improved threaded screw fastener which has, for example, a single continuous helical thread integrally formed thereon, and wherein there has been provided, upon the outer peripheral edge regions of the leading thread crest portions of such single continuous helical thread, a plurality of contiguous saw-blade teeth which will effectively cut through side wall portions of bores formed within a particular substrate and remove such severed material, as opposed to simply moving or displacing the material forming the side walls of the substrate bores as is conventionally achieved by PRIOR ART self-tapping threaded fasteners. This cutting and removal action accomplished by means of the new and improved threaded screw fastener of the present invention therefore leads to a faster and smoother insertion of the fastener into a particular substrate, and the fact that material is actually cut and removed from the side wall portions of the substrate bores permits the following or trailing threads to be inserted or installed more easily. Accordingly, the overall required insertion torque levels are substantially reduced, and due to the well-defined cuts within the side walls of the substrate, the pull-out resistance values characteristic of the fasteners are substantially enhanced. The fasteners of the present invention are also able to be used in connection with a diversity of substrates comprising different materials, such as, for example, wood, metal, composites, concrete, and the like. Obviously, many variations and modifications of the present invention are possible in light of the above teachings. It is therefore to be understood that within the scope of the appended claims, the present invention may be practiced

otherwise than as specifically described herein.

Claims

5. 1. A threaded fastener, comprising: a shank portion (12); a head portion (14) formed upon a first end of said shank portion, a tip portion (16) formed upon a second opposite end of said shank portion; a substantially continuous single helical thread (22) formed upon said shank portion, wherein individual thread portions of said substantially continuous single helical thread comprise crest portions; and a plurality of substantially contiguous saw-blade type teeth (30) formed upon peripheral edge portions of said crest portions of said individual thread portions of said substantially continuous single helical thread.
10. 2. The threaded fastener as set forth in Claim 1, wherein: each one of said plurality of saw-blade type teeth (30) has a substantially triangular configuration.
15. 3. The threaded fastener as set forth in Claim 2, wherein: valleys (34) are defined between successive ones of said plurality of substantially contiguous substantially triangular-shaped saw-blade type teeth.
20. 4. The threaded fastener as set forth in Claim 3, wherein each one of said valleys comprises an included angle of 100°.
25. 5. The threaded fastener as set forth in Claim 1, wherein: said plurality of substantially contiguous sawblade type teeth (30) are only formed upon peripheral edge portions of said crest portions of leading ones of said individual thread portions of said substantially continuous single helical thread (22).
30. 6. The threaded fastener as set forth in Claim 5, wherein: said leading ones of said individual thread portions of said substantially continuous single helical thread (22) comprises approximately the leading one-third to one-half of the number of individual thread portions of said substantially continuous single helical thread formed upon said shank portion of said threaded fastener.
35. 7. The threaded fastener as set forth in Claim 1, wherein: said plurality of substantially contiguous sawblade type teeth (30) have a predetermined pitch defined between adjacent ones of said plurality of substantially contiguous saw-blade type teeth; and each one of plurality of substantially contiguous saw-blade type teeth has a predetermined radial depth dimension.
40. 8. The threaded fastener as set forth in Claim 7, wherein: said threaded fastener comprises either one of a number six and a number eight sized threaded fastener; said predetermined pitch defined between said plurality of substantially contiguous saw-blade type teeth comprises 0.60 mm; and each one of plurality of substantially contiguous saw-blade type teeth has a predetermined depth dimension of 0.21 mm.
45. 9. The threaded fastener as set forth in Claim 7, wherein: said threaded fastener comprises either one of a number ten and a number twelve sized threaded fastener; said predetermined pitch defined between said plurality of substantially contiguous saw-blade type teeth comprises 0.70 mm; and each one of plurality of substantially contiguous saw-blade type teeth has a predetermined depth dimension of 0.25 mm.
50. 10. The threaded fastener as set forth in Claim 7, wherein: said threaded fastener comprises a number fourteen sized threaded fastener; said predetermined pitch defined between said plurality of substantially contiguous saw-blade type teeth comprises 0.80 mm; and each one of plurality of substantially contiguous saw-blade type teeth has a predetermined depth dimension of 0.29 mm.
11. The threaded fastener as set forth in Claim 1, wherein: each one of said individual thread portions of said substantially continuous single helical thread comprises an upper flank surface and a lower flank surface; and an included angle defined between said upper flank and lower flank surfaces is within the range of 30-50°.

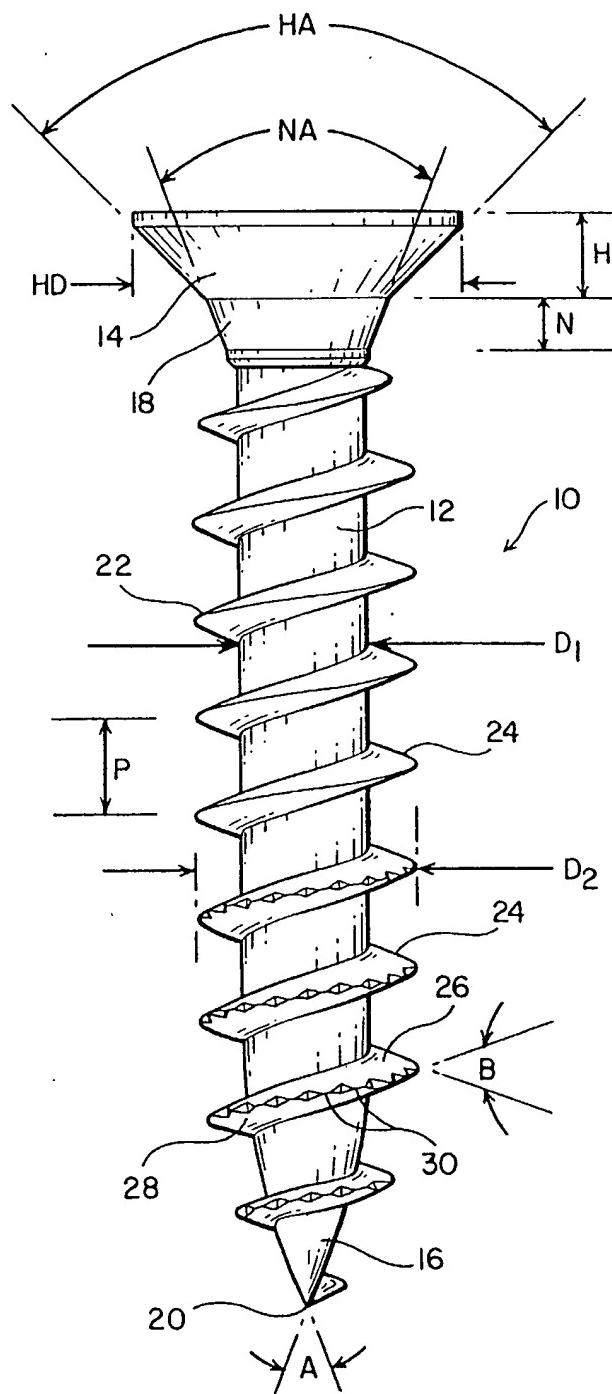


FIG. I

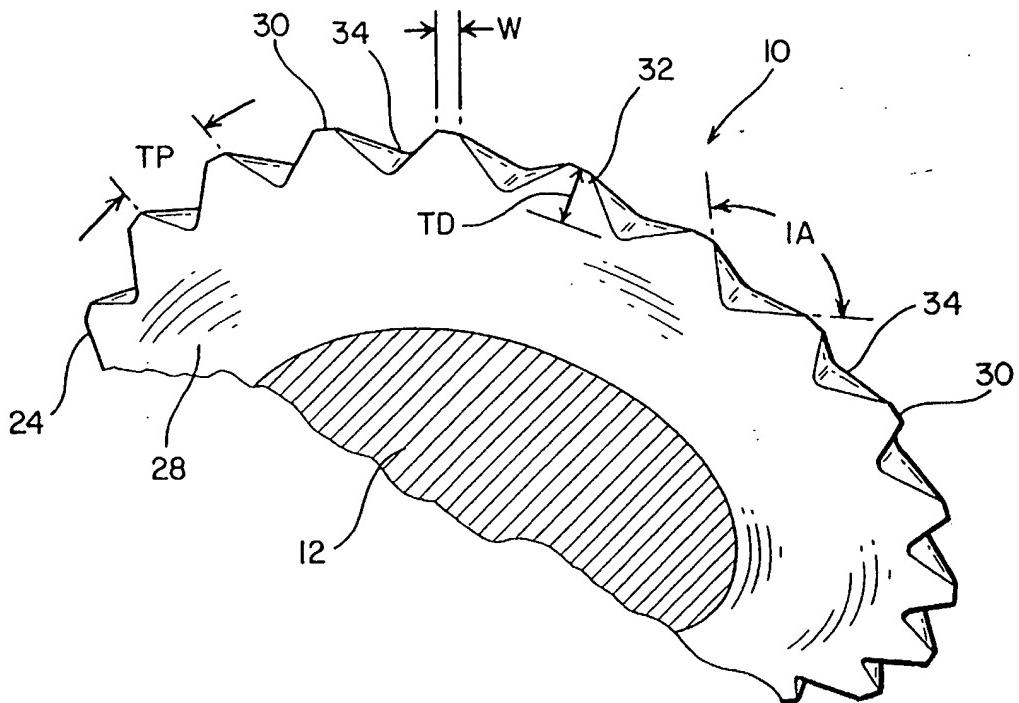


FIG. 2